it is spaced from the free ends **116** of the leads **115**. The die **120** includes an upper (first) surface **122** and a lower (second) surface **124**, and also includes a plurality of die bond pads **126** located on the upper surface **124**. The die bond pads **126** are electrically connected to the integrated circuit (not shown) which is fabricated on the die **120**, and are also electrically connected to the upper surfaces **112** of selected leads **115** via wires **130** using known wire bond techniques. A plastic casing **160** is formed over lead frame **110**, die **120** and wires **130** for protection.

In accordance with a first aspect of the present invention, the lower surfaces **114** and **124** are exposed through the plastic casing **160**, thereby facilitating rapid heat dissipation from the die **120**, and thereby enhancing thermal performance of the electronic device **100**. In particular, when the electronic device **100** is mounted on a circuit board in a "cavity up" arrangement (i.e., such that the lower surfaces **114** and **124** face a surface of the circuit board), the die **120** can be mounted directly onto a heat sink formed on the circuit board. The direct contact between the die **120** and the heat sink provides significantly better heat dissipation over that of the known enclosed-die package shown in FIG. **1** of the present application. The electronic device **100** can also be beneficially used in a "cavity down" arrangement (i.e., such that the lower surfaces **114** and **124** face away from the printed board) by providing suitable ventilation and/or a heat sink structure mounted directly onto the die **120**.

In accordance with a second aspect of the present invention, the lower surface **114** of the lead frame **110** is co-planar with a lower surface **124** of the die **120**. This arrangement yields a very low-profile package when compared with the known enclosed-die package shown in FIG. **1** of the present application.

FIGS. **2–6** show a method for producing an electronic device using the plastic package formed in accordance with the present invention.

Referring to FIGS. **2A** and **2B**, the lead frame **110** is formed from a thin metal (e.g., copper) strip which has been etched or stamped to form a pattern similar to that shown in FIG. **2A**. The upper (first) surface **112** and the opposing lower (second) surface **114** are indicated in FIG. **2B**. Each of the radial leads **115** has a free end **116** and a fixed end **117**. The free ends **116** of the plurality of leads **115** surround and define the central opening **118**. The fixed ends **117** of the leads **115** are connected to a skirt **119**, which is removed after the plastic casing **160** is formed, as described below. It is noted that the lead frame **110** shown in FIG. **2A** is simplified for clarity. A lead frame **110** used in an actual package may have a different shape than that shown in FIG. **2A**, and typically includes many more leads **115**.

Referring to FIG. **3**, the lead frame **110** is mounted on an adhesive tape **170** such as polyimide with an adhesive layer. The purpose of the adhesive tape **170** is to support the die **120** and lead frame **110** during the assembly process, and to maintain the die **120** in a proper location relative to the lead frame **110**. Specifically, the lower surface **114** of the lead frame **110** contacts a sticky surface **172** of the adhesive tape **170**, and the upper surface **112** of the lead frame faces away from the adhesive tape **170**. A central portion **174** of the adhesive tape **170** remains exposed through the central opening **118** of the lead frame **110**.

Referring to FIG. **4**, the die **120** is then mounted on the central portion **174** of tie adhesive tape **170**. Specifically, the die **120** is positioned in the central opening **118** such that the lower surface **124** of the die **120** contacts the sticky surface **172** of the adhesive tape **170**, and the upper surface **122** of the die **120** faces away from the adhesive tape **170**. The sticky surface **174** supports the lead frame **110** and the die **120** such that the lower surfaces **114** and **124** are co-planar.

Referring to FIG. **5**, wires **130** are then connected between the die bond pads **126** and the leads **115** using known wire bond techniques.

Referring to FIG. **6**, the molded plastic casing **160** is then formed over lead frame **110**, die **120** and wires **130** using known plastic molding methods (such as transfer molding) while the lead frame **110** and die **120** remain mounted on the adhesive tape **170**. During the molding process, liquified molding material flows onto exposed portions of the adhesive tape **170** which are located between the die **120** and the free ends **116** of the lead frame, and between the leads **115**. This molding material solidifies to form intervening portions **162** which serve to maintain the relative positions of the die **120** and leads **115**. After encapsulation, skirt **118** is removed by trimming.

Finally, as shown in FIG. **7**, the adhesive tape **170** is removed from the die **120** and the lead frame **110**, thereby exposing the lower surface **124** of the die **120**, the lower surface **114** of the lead frame **110**, and lower surfaces **164** of the intervening portions **162**, all of which being co-planar.

The device **100** shown in FIG. **7** can be attached to a circuit board using several possible methods. For example, a BGA package format may be obtained by trimming the leads **115** such that they are flush with a side surface **166** of the plastic casing **160**, and attaching solder balls or columns to the lower surfaces **114** of the leads **115**. Alternatively, the skirt **119** can removed by cutting the leads **115** near the fixed ends **117**, and then bending the leads to provide contact with a circuit board.

While particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects. For example, the lead frame may have any known configuration, and is not intended to be limited to the construction of lead frame **110** shown in FIGS. **2A** and **2B**. Further, the steps of mounting the die **120** and lead frame **110** onto the adhesive tape **170** shown in FIGS. **3** and **4** may be reversed. Moreover, glob top material may be used in place of the molded plastic casing **160**. Therefore, the appended claims are to encompass within their scope all such changes and modifications as fall within the true spirit and scope of this invention.

What is claimed is:

1. A method for producing an electrical device comprising the steps of:

forming a flat lead frame including a plurality of leads extending radially from a central opening the lead frame having opposing upper and lower surfaces;

mounting the lead frame and an integrated circuit die onto a strip of adhesive tape such that a lower surface of the die contacts the adhesive tape and the die is located in the central opening, and the lower surface of the lead frame also contacts the adhesive tape;

forming a plastic casing over an upper surface of the die and the upper surface of the lead frame; and

removing the adhesive tape to expose the lower surfaces of the die and the lead frame.

2. The method according to claim 1, wherein the die includes a plurality of die bond pads, and the method further comprises the step of electrically connecting each of the die bond pads to a selected one of the plurality of leads.

3. The method of claim 2, wherein the step of electrically connecting comprises wire bonding.

4. The method of claim 1, wherein the step of forming the lead frame comprises etching a metal sheet.

5. The method of claim 1, wherein the step of forming the lead frame comprises stamping a metal sheet.

6. The method of claim 1, wherein the step of forming the plastic casing comprises molding plastic onto the upper surfaces of the die and the lead frame.

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